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Procedia Computer Science 64 (2015) 957 – 963

Procedia Computer Science

Conference on ENTERprise Information Systems / International Conference on Project MANagement / Conference on Health and Social Care Information Systems and Technologies, CENTERIS / ProjMAN / HCist 2015 October 7-9, 2015

Narrowing impact factors for Innovative Software Project Management

Robson Maranhão*, Marcelo Marinho, Hermano de Moura

Informatics Center (CIn), Federal University of Pernambuco (UFPE), Recife – PE, Brazil

Abstract

A large number of project management approaches do not consider the impact that innovations have on projects. Innovation is one of the keys to success in organization, however, the threats identified by innovation in a project day-to-day are real and expectations in a project are often high. Innovative Software Project has a high level of uncertainty and complexity, leading us to suggest that we need a specific approach to manage these threats. The use of management innovation in project can be a determining factor in project success. This paper discusses main impact factors related to Innovative Software Project Management (ISPM) from the findings of systematic literature review about ISPM, aiming to understand how these factors can affect ISPM and contribute to the improvement and success of software projects.

Peer-review under responsibility of SciKA - Association for Promotion and Dissemination of Scientific Knowledge

Keywords: Software Project Management; Systematic literature review; Innovation in Projects Management; Innovative Software Projects.

1. Introduction

An innovation is the realization of either a new or significantly improved product (good or service) or process. It can be a new marketing method or a new organizational method in business practices (managerial method) [1].

* Corresponding author.
E-mail address: rgam@cin.ufpe.br

Peer-review under responsibility of SciKA - Association for Promotion and Dissemination of Scientific Knowledge
doi:10.1016/j.procs.2015.08.613

Innovative Project can be highly unpredictable, although the level of uncertainty will vary according to several factors. The adoption of new or significantly improved or processes or marketing method or organizational methods products are replete of uncertainties. In addition, the complexity of the innovation process is difficult to establish precise approaches to management[1].

Marinho, Sampaio and Moura[2] argued that innovation and projects aimed at innovation development, being them a new product, process or service, should be on the executive diary, along with the understanding of the business environment changes and the action plan needed to respond to, or influence these changes.

Filippov and Mooi[3] presented the importance of technology and innovation in the organization change, growth and profitability as well as the close connection between development of innovation and projects. The authors believe that an innovative project should have at least one of the following criteria: (i) development of an innovative product or service; (ii) applying of innovative methods and approaches (process innovation); (iii) improving the capacity for innovation and organizational learning; (iv) having a high integration with the project owner (user innovation).

Wu, Rose and Lyytinen[4] argued that large and innovative projects have a high level of uncertainty and complexity, requiring an unbounded and non-linear risks management. According to Moe et al[5], one of the critical issues identified is the insufficient innovation. Good innovation management practices can help overcome these problems, however, the successful implementation is difficult.

O'Connor and Rice[6] argued that a large number of perspectives emerge from the literature to explain why companies have difficulty in managing the various uncertainty sources associated with converting innovations into innovative companies. Understanding the innovative project characteristics and the uncertainty nature that permeates them is critical for developing appropriate management practices.

Filippov and Mooi[3] showed that innovative projects by their nature differ from conventional projects. Therefore, it is necessary to discuss the Innovation Project Management as a distinctive area of managing innovation in projects, using the tools and project management methods.

In line with Filippov and Mooi[3], Dodevska, and Mihic[7] highlight that innovative projects have a high degree of uncertainty and risk, differing from the conventional projects, therefore, cannot be managed in the same way.

We have adopted the term *Innovative Software Project Management* (**ISPM**) to represent the software projects management when innovation is present in product, process, technology or management. Thus, the scope of the research is to investigate **ISPM**.

This study is part of a broader research that seeks to investigate **ISPM**, the factors influencing, related management practices and how it can foster innovation in order to support and improve organizational performance.

Systematic Literature Review (**SLR**) provides ways to implement comprehensive and not biased literature reviews, making their results have scientific value as advocated by Travassos and Biolchini[8]. **SLR** aims to present a fair assessment of a research topic, using a reliable, accurate and auditable methodology[9].

Aiming to better understand and explore the topic, a **SLR** was conducted to identify what factors affect **ISPM**. Previous research found the following factors that affect project management (**PM**), which are: tools, techniques, processes, practices, organizational capabilities and IT assets.

A **SLR** process has three main phases: planning, conducting and reporting the review. The authors developed it with related studies from 1995 to 2014. Guided by research questions, the study aims to investigate three research questions (**RQs**) to identify what factors affect ISPM, as shown in Table 1.

Table 1. Research Questions.

	Research Question
RQ1	Which tools and techniques can support ISPM?
RQ2	Which processes and practices are adopted in ISPM?
RQ3	Which is the relation between organizational capabilities and IT asset with ISPM?

This research helps identifying the factors that may foster innovation and minimize the uncertainty effects in innovative projects and how managers and teams may prepare themselves for the challenges in their project scenarios, based on the **SLR** which was done.

Besides this introductory section, the paper is structured as follows: In section 2 we describe the method adopted for this study; section 3 presents our key findings and section 4 contains the conclusion.

2. Methodology

According to Kitchenham et al[10], evidence-based software engineering aims to provide means by which the best evidence from research can be integrated with practical experience and human values in the decision-making process considering the development and software maintenance. The essence of evidence based paradigm is systematically collect and analyzes all available data about a phenomenon for a more comprehensive and broader perspective than one can capture through a single study. **SLR** is a methodology for this purpose.

2.1. Systematic Literature Review Process

SLRs evaluate evidence in a systematic and transparent way. It starts with the protocol definition and the process is composed of five phases: (1) Search, (2) First selection - **1S**, (3) Second selection - **2S**, (4) Data extraction & Quality assessment - **DE & QA** and (4) Data synthesis - **DS**, as shown in Figure 1.

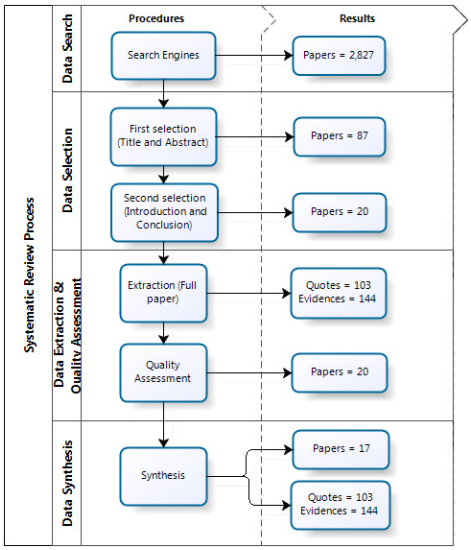

Fig. 1. Systematic Review Process.

Searches of the primary studies can be performed on digital libraries. Thus, data sources adopted for searching the studies were: (1) Scopus; (2) Elsevier ScienceDirect; (3) Wiley Online Library; (4) IEEEXplore Digital Library; (5) Springer Link and (6) ACM Digital Library.

In the **Search phase**, 5,282 hits were found. A total of 2,455 papers were identified as duplicate, leaving 2,827 papers for Selection phase. Figure 2 shows the number of papers found per engine and phase.

As result of the **First Selection phase**, **87** papers were selected to the list of potential primary papers. In the **Second Selection phase**, only **13** papers were selected to the next phase. Each researcher conducted secondary searches and **7** secondary papers were selected. Thus, a total of **20** papers were selected for the next phase.

During **Quality assessment phase**, **20** papers were assessed and **three** were eliminated by research questions not being answered. Therefore, **Data extraction** was performed in **17** papers and produced **103 quotes and 144 evidences**, i.e., some quotes had more than one evidence. In the **Synthesis phase**, all quotas were analyzed and all research questions were answered. In order to assist the study analysis, some protocol information are available at www.innovativesoftwarepm.org/slr-ispm-up-to-2014/protocol.

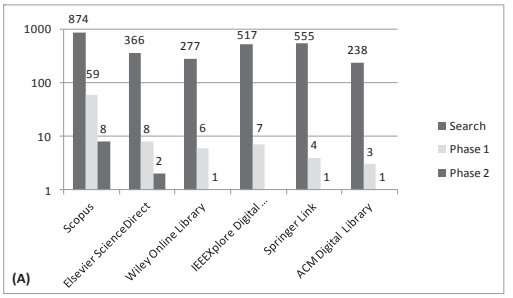

Fig. 2. Paper selected per engine Studies Selected.

3. Findings

Unfortunately, our review did not identify any previous **SLR** about **ISPM**, thus this work can be considered the first **SLR** about the theme, in which we found 17 studies directly or indirectly related to this domain.

This section discusses our results and findings about factors that affect ISPM, followed by research questions and the implications of the findings for research and practice and emerging contributions.

As stated in section 1, innovative projects require new ways to manage them, since it is necessary to include more creativity when compared with standard processes. Moreover, the traditional project management tools are often not useful in managing innovation projects[7].

The paradigm of complexity supports innovation because there is a strong link between chaos and creativity[21]. Innovation projects are not structured, their future is uncertain, and the usual tools for conventional project management are often not useful in this context. In the group of tools and techniques, Dodevska, and Mihic[7] suggested the use of two factors to support the ISPM. The inclusion of fuzzy numbers in the project planning phase, helping project manager to avoid subjectivity in defining of activity duration. Another factor is the application of analytical Risk Breakdown Matrix, helping to manage risks and reduce uncertainty.

Creation and use of collective intelligence has been applied in various fields such as pervasive systems, distributed mobile and robotics. Through social media, we can capitalize on the intellect of the team members, as well as, of people outside the project. Among the solutions inspired this context, Crowdsourcing has proved a successful tool, enabling communication and integration of people and knowledge sharing within the organization. Due to these features, Crowdsourcing has been the subject of several studies for the best project management[11].

Rodríguez-García et al[12] discussed the use of social media as a platform to foster innovation. Through the Semantically-enhanced platform, innovation related data are model using ontologies. Applying semantic techniques and methods, it is possible to improve the open innovation management. We agree that the use of techniques to reduce uncertainties and tools to promote innovation through problem solving and generating collaboratively knowledge can support the ISPM.

Organizational capabilities (**OC**) are one of the factors which affect the ISPM. Bannerman[13] described it as: *"Capabilities are organizational resources that have potential to generate value for a firm. They comprise an intricate mix of knowledge, skills, routines, technologies and values"*. Complementing this definition, Koc[14] included: *"…the ability to develop new technologies, products and processes"* as **OC**.

To succeed in ISPM, the organization should promote the generation of ideas by their ability to innovative behavior, supported by organizational capabilities. Davies and Brady[15] stated that to succeed in NPD (New Product Development) an organization needs a structure that allows sharing of information and other scarce resources across functional areas and supporting decision making and conflict resolution.

Innovation projects require adaptation of existing processes and routines to meet the new characteristics of these projects. This adaptation produced an organization with more organic, flexible and informal style, accommodating the task diversity, novelty and scale of the projects undertaken[14].

We believe that promoting the generation of ideas by creating an adaptable and flexible framework for an innovative project; using of techniques to reduce uncertainties and tools to promote innovation through problem solving and generating collaboratively knowledge can support the ISPM.

In the group of processes and practices, we found evidence of several factors adopted to favor the ISPM. These factors can be categorized as processes and practices but for better comprehension we categorized such factors as: Models and Approach.

In the category of models and approaches, Deakins and Dillon[16] presented the Helical model that focuses on innovative and creative solutions, it also suggests experimentation, continuous customer feedback and prototyping. The Helical model provides an adequate development methodology for the development of innovation projects in volatile environments which require: innovative and creative solutions through experimentation; rapid and high quality development; continuous improvement to specifications via high customer feedback levels and responsiveness to internal and external environments.

Another model was found in Wu, Rose and Lyytinen[7], where the need for a new approach is presented in ISPM: *"A major challenge therefore for conducting these large projects is the need to manage unbounded and non-linear risks reflecting the high level of uncertainty and complexity that arise over the course of a large and innovative project"*. The authors presented a new project management practices to manage ***Black swan*** projects (highly-innovative projects). They developed these practices out of necessity to manage the challenges of these atypical projects.

Wu, Rose and Lyytinen[7] presented a new project management practices to manage Black swan projects (highly-innovative projects). They developed these practices out of necessity to manage the challenges of these atypical projects. Three practices were presented: (i) careful and elongated up-front planning, (ii) exploration of identified innovation-points, and (iii) proper integration of innovation point sub-projects.

Kettunen and Laanti[17] analyzed the software process models in embedded development context. It presents a matrix that supports the appropriate model selection for each project reality. Relative to our study subject, three realities were identified: (i) Underestimation of project size, complexity, novelty; (ii) Research-oriented development; and (iii) New, immature software technology. Among the suitable models presented there are the Spiral model, Feature-driven development (FDD) and Adaptive software development (ASD).

Research on Agile approach to project management has received great attention. Kettunen and Laanti[17] stated that the Agile approach is right for innovative projects. Other studies reinforce the appropriateness of the Agile approach when projects involve a high degree of uncertainty, requiring creativity, innovation and flexibility.[12,15]

As result, Conforto and Amaral[19] presented the Iterative and Visual Project Management Method (IVPM2), based on APM principles as described in the literature.

Lastly, Berggren, Järkvik, and Söderlund[20] presented three practices which together represent a neo-realistic approach to project management, based on a reflective and experience to organizing projects: *"...neo-realistic project management: lagomized project management, organic integration, and Systems Emergency Wards. These management innovations add to the understanding of the role played by project management in complex systems development"*.

In the processes and practices category several factors that can favor the ISPM were observed. Some have already been mentioned in the previous paragraphs: Experimentation, Prototyping, Lagomizing, Organic integration and Systems emergency ward. Davies and Brady[14] investigated which factors that have significant impact on the innovation capacity of companies. To allow the creativity, some processes were presented: Collaboration, Idea generation and Deal with multifunctional teaming. To foster the human resource, leveraging the skills, expertise and knowledge, some practices were presented: Training, Rewarding and Following the technological developments

We believe that these evidences contributes to understand that innovative projects need specific processes and practices to foster the creativity and idea generation to deal with uncertainties and complexity projects through a agile, collaborative and flexible management, as ISPM.

4. Conclusion

The project-based approach becomes increasingly relevant on the organizational environment. In fact, we can realize that is time to unleash the power and energy embedded in the projects. Considering significant project failure

rate, it becomes imperative for the organization to pay more attention to their project activity, their potential and the competitive advantages they can bring. Innovation is one of the keys to success for organizations and is usually implemented through projects. Due to its importance and peculiarity, innovation projects should be managed differently from conventional projects.

Our findings show that the number of papers on innovation projects has been growing since the last decade, as well as the increased awareness of the challenges for the management of these projects. During the systematic review process some factors have been identified that affect the management and performance of innovation projects. Our research identified four tools and techniques that allow better planning and monitoring, helping to manage the initiatives to reduce uncertainty; or encourage innovation through a collaborative platform. We found evidence that an organic, flexible and informal structure of the organization enables the generation of ideas and innovative behavior. In terms of processes and practices, we have identified several models for innovation management, highlighting the agile approaches; as well as three processes and eleven practices that promote creativity, idea generation and collaboration to foster innovation in projects.

Finally, our findings contribute to the software project management providing a better understanding of the challenges of dealing with ISPM and, thus, show how to deal with the innovation, the factors affecting ISPM and that can support practitioners and researchers in identifying relevant challenges and developing solutions for projects.

The scope of the research is limited to software projects and research results cannot be generalized, however, the management of some factors identified here could impact on the success of other project types. As future works, empirical studies should be conducted to assess the adoption and integration of factors presented in this study.

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